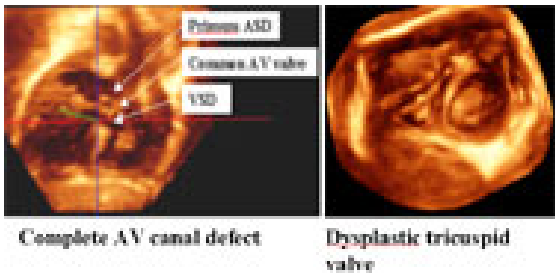
8:45 a.m.

871-2 **New Anatomical Insights From Three-Dimensional Echocardiography for Congenital Heart Disease: Blinded Interpretation by Experts Reveals Additional Anatomical Features Not Delineated by 2-D Echocardiography**

Aarti Hejmadi Bhat, Xiaokui Li, Rima S. Bader, David J. Sahn, Oregon Health & Science University, Portland, OR

Background: The new 2-4MHz Live 3D implementations are not designed specifically for use in small children, but using highest frequency and low power output improves results.
Methods: We performed focused 3D studies on 50 children with significant CHD attending the cardiology clinic at OHSU using the Philips 7500 Live 3D system. Optimized biplane and Live 3D views were acquired and analyzed by blinded observers.
Results: Real time 3D studies were done in 53 patients (2 wks-16 yrs) [TOF 4; tricuspid anomalies 7, mitral 3, aortic 9; VSD 7; AV canal defects 4; PDA 3; cardiomyopathy 1; and complex CHD 15]. All carried a working diagnosis from their preceding 2D echo studies. Time for 3D acquisition was 8-10 min, post-acquisition analysis varied with the degree of anatomical detail being sought. Blinded 3D analysis by 2 experts showed 100% accuracy in making the basic diagnosis from 3D data only while providing new diagnostic detail in many cases. Unusual views and multiplanar navigational ability within the 3D data set gave additional information: AV valve anatomy and chordal attachments, coronary artery patterns, outflow obstructions at multiple levels, valve and conduit stenosis, residual coarctations could be identified and quantified. Five new diagnoses were made in the 50 patients, at least 2 of them were pertinent to management decisions.
Conclusions: Versatile post-acquisition analysis of Live 3D volume data gives unique insight into anatomic details of CHD with a potential for enhanced information yield.



9:00 a.m.

871-3 **Diagnosis and Management of Foramen Ovale Restriction or Closure in Fetuses With Congenital Heart Disease**

Mary T. Donofrio, Yvonne A. Bremer, Scott D. Gullquist, William B. Moskowitz, Virginia Commonwealth University, Richmond, VA

Patency of the foramen ovale (FO) is critical for fetal well-being. We hypothesize that 1) FO restriction/closure is more common in fetuses with congenital heart disease (CHD), especially those with obligate atrial shunts and/or left atrial hypertension (LA HTN); 2) fetuses with CHD, especially those with obligate right to left atrial shunts, are more likely to have distress from FO restriction/closure; 3) the FO may close late in gestation as lung flow increases.
Methods: Fetal echo charts were reviewed. Fetuses with a restrictive/closed FO were identified. CHD fetuses were grouped by diagnosis: Gr I- obligate right to left atrial shunt (hypoplastic right heart); Gr II- obligate left to right atrial shunt (hypoplastic left heart); Gr III- CHD at risk for LA HTN (aortic/mitral disease, transposition). Data were analyzed to determine if the risk of fetal distress or poor outcome from FO restriction/closure was greater for Gr I-III fetuses compared to those with normal hearts or other CHD. Gr I-III studies were reviewed to identify features that might have predicted FO restriction/closure. Charts were reviewed to assess management plan, clinical course and outcome.
Results: Of 381 fetuses, 116 had CHD. Six (5%) with CHD had a restrictive/closed FO; 2/16(13%) in Gr I, 2/30(7%) in Gr II, and 2/9(22%) in Gr III. No fetus with a normal heart had FO restriction/closure. In Gr I no features were identified that predicted FO closure. In Gr II FO restriction/closure was noted early in gestation. For Gr III early ultrasounds were reportedly normal. Persistent hydrops developed in 2 Gr I fetuses with FO restriction. Aggressive management was undertaken in all fetuses. Outcomes were dismal; 4 died (1 in Gr I, 1 in Gr II, 2 in Gr III). The 2 survivors had prolonged hospitalizations.
Conclusion: The risk of FO restriction/closure is greater in fetuses with CHD, particularly those with obligate atrial shunts and/or LA HTN. FO restriction/closure in CHD fetuses can result in distress in-utero or at birth. Fetuses with obligate right to left atrial shunts are more likely to have hydrops. The FO can close in the 3rd trimester. We suggest serial assessment for at risk fetuses. These fetuses may be ideal candidates for in-utero intervention.

9:15 a.m.

871-4 **Creation of an Atrial Septal Defect in Utero for Fetuses With Hypoplastic Left Heart Syndrome and Intact or Highly Restrictive Atrial Septum**

Audrey C. Marshall, Mary E. van der Velde, Wayne Tworetzky, Louise Wilkins-Haug, Carol B. Benson, Russell W. Jennings, James E. Lock, Children's Hospital, Boston, MA, Brigham and Women's Hospital, Boston, MA

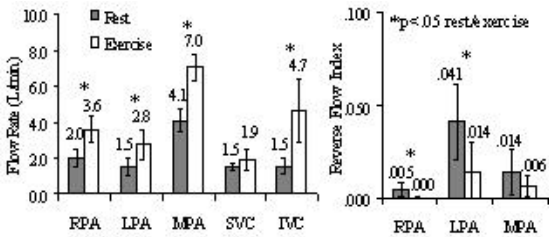
Background: Infants born with hypoplastic left heart syndrome and an intact or highly restrictive atrial septum face a neonatal mortality of at least 48%, despite early postnatal left atrial decompression and palliative surgery. Prenatal intervention to decompress the hypertensive left atrium has been suggested as a means of improving the outcomes of these infants, but the feasibility of such a procedure has not been demonstrated. Methods: Five fetuses with hypoplastic left heart syndrome and intact or highly restrictive atrial septum at 26 to 34 weeks gestational age, underwent prenatal intervention. 4 of 5 mothers received general anesthesia for the procedure, to achieve maximal uterine relaxation. Under ultrasound guidance, the atrial septum was punctured and dilated using an introducer placed percutaneously from the maternal abdominal surface. Results: All five procedures were technically successful. Balloon dilation of the iatrogenic atrial septal defect resulted in small, but persistent, communications between the atria as demonstrated by follow-up fetal echocardiography. One fetus died following the procedure; death was attributed to traumatic myocardial injury and effusion. Three fetuses were liveborn at term, and one remains in utero. There were no maternal complications. Conclusions: Ultrasound-guided fetal atrial septoplasty is feasible, and can be performed percutaneously to minimize maternal risk. Technical refinements, and development of use-specific catheters, may decrease the risk of fetal injury and improve results.

9:30 a.m.

871-5 **Upright Seated Pulmonary and Caval Blood Flow Characteristics During Rest and Cycling Exercise Using Magnetic Resonance Imaging**

Christopher P. Cheng, Robert J. Herfkens, Amy L. Lightner, Charles A. Taylor, Jeffrey A. Feinstein, Stanford University, Stanford, CA

Background: Patients with congenital heart disease undergo diagnostic testing while supine and at rest – conditions not representative of their typical hemodynamics. Upright, exercise measurements of blood flow may prove valuable in the assessment of these patients but data in normal subjects is first required.
Methods: Using a General Electric 0.5T open-magnet, a custom magnetic resonance-compatible exercise cycle and cine-phase contrast techniques, time-dependent blood flow velocities were measured in the pulmonary arteries (MPA, RPA, LPA) and vena cavae (SVC, IVC) of ten healthy 10-14 year-olds. Measurements were made at rest and during upright cycling exercise (150% resting heart rate). Mean blood flow (L/min) and reverse flow index were computed from the velocity data.
Results: With exercise, RPA and LPA mean flow increased: 2.0 ± 0.5 to 3.6 ± 0.7 ($p<.05$) and 1.5 ± 0.5 to 2.8 ± 0.8 ($p<.05$), respectively, while SVC and IVC flow increased from 1.4 ± 0.3 to 1.9 ± 0.6 and 1.5 ± 0.5 to 4.7 ± 1.8 ($p<.05$), respectively.PA reverse flow index (rest vs. exercise) decreased with exercise: MPA: .014 ± .012 vs. .006 ± .006, LPA: .041 ± .021 vs. .014 ± .016 ($p<.05$), RPA: .005 ± .004 vs. .000 ± .000 ($p<.05$).
Conclusion: Relative flow distribution between right and left lungs (56% vs. 44%) remained consistent from rest to exercise. IVC flow increases significantly relative to SVC flow with cycling exercise (3:1 vs. 1:1). Reverse flow observed in the MPA appears to originate solely from the LPA.



9:45 a.m.

871-6 **Magnetic Resonance Imaging Evaluation of Myocardial Perfusion and Viability in Congenital and Acquired Pediatric Heart Disease**

Ashwin Prakash, Andrew J. Powell, Rajesh Krishnamurthy, Tal Geva, Children's Hospital, Boston, MA, Harvard Medical School, Boston, MA

Background: Studies in patients with ischemic heart disease have shown that contrast-enhanced myocardial delayed enhancement (MDE) MRI detects myocardial viability with high sensitivity and specificity and that it has superior spatial resolution as compared with radionuclide techniques. However, studies of MDE have focused on adults with coronary artery disease. The goal of this study was to determine whether the transmural extent of hyperenhancement on MDE corresponds to regional wall motion abnormalities (RWA) evaluated by cine MRI in patients with congenital heart disease (CHD).
Methods: We analyzed the MRI studies of 30 patients with congenital and acquired pedi-